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(54) THIN BATTERY

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a thin battery with excellent air tightness and mechanical strength.

SOLUTION: A cathode 1, an anode 2, and an electrolytic substance 3 are housed in a moisture-proof multilayered film 4 constituted of a polymer film layer and a metal foil layer and the electrode terminals 5, 6 to connect the electrodes and the outside terminals

are made of a net like or porous conductor. By using the net-like or porous conductor for the electrode terminals 5, 6, the electrode terminals 5, 6 and the moisture proof multilayered film 4 are firmly joined to each other. Moreover, by making the thickness of the polymer film layer of the sealing part X penetrated with the electrode terminals 5, 6 thick, short circuiting of this battery can be prevented.

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**CLAIMS**

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[Claim(s)]

[Claim 1] The thin cell characterized by the electrode terminal to which the dampproof multilayer film which consists of a poly membrane and a metallic foil comes to contain a positive electrode, a negative electrode, and an electrolyte, and they connect an electrode and an external terminal consisting of a reticulated or porous conductor.

[Claim 2] The thin cell according to claim 1 by which a reticulated or porous conductor

is characterized by being [ of the aggregate of a metal network, an expanded metal, a punching metal, and a carbon fiber ] either at least.

[Claim 3] The thin cell according to claim 1 by which a reticulated or porous conductor is characterized by being [ of carbon, nickel, aluminum, copper, a tungsten, stainless steel, iron, silver, gold, the alloy containing these, or the metal with which these were plated ] either at least.

[Claim 4] The thin cell according to claim 1 characterized by for a negative electrode consisting of a metal lithium, for a positive electrode consisting of an ingredient which can carry out occlusion of the lithium ion, and an electrolyte consisting of nonaqueous electrolyte, a solid electrolyte, or a gel electrolyte.

[Claim 5] The thin cell according to claim 1 characterized by for a negative electrode consisting of either of the ingredients which can carry out the ejection and insertion of a metal lithium, a lithium alloy, and the lithium irreversibly, for a positive electrode consisting of an ingredient which can carry out the ejection and insertion of the lithium irreversibly, and an electrolyte consisting of nonaqueous electrolyte, a solid electrolyte, or a gel electrolyte.

[Claim 6] The thin cell according to claim 1 by which thickness of the poly membrane of the obturation section which the poly membrane came to obturate opening of a dampproof multilayer film, and the electrode terminal has penetrated is characterized by being thicker than other obturation parts.

[Claim 7] The thin cell according to claim 6 characterized by assigning the piece of resin to the field which is equivalent to the obturation section of an electrode terminal, or covering with resin the field which is equivalent to the obturation section of an electrode terminal.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates especially to electrode terminal structure about the thin cell used for small lightweight-ized implementation of a portable electronic device etc.

[0002]

[Description of the Prior Art] In recent years, an industry top cell is occupying an

important location as a power source of a portable electronic device. For small lightweight-sized implementation of a device, containing efficiently to the tooth space to which the cell was restricted in the device is called for. It is supposed at this that a lithium cell with large energy density and output density is the most proper.

[0003] moreover, coincidence -- a small lightweight-sized implementation of a device sake -- a flexible cell with a high gestalt degree of freedom or the sheet mold cell of a thin large area, and a thin shape -- a facet -- a card mold cell of a product is desired. However, this demand cannot be met when the metal can used conventionally is used for sheathing.

[0004]

[Problem(s) to be Solved by the Invention] Then, using for a sheathing material the dampproof multilayer film which consists of macromolecule membrane layer metallurgy group foil layers is proposed. With the hot seal, especially the dampproof multilayer film that consists of a thermal melting arrival nature macromolecule membrane layer and a metallic foil layer can realize sealing structure easily, and the reinforcement of the film itself and airtightness are excellent. For this reason, the dampproof multilayer film is promising as a candidate of the sheathing material of a cell with a high gestalt degree of freedom, or a thin cell.

[0005] however, the above-mentioned dampproof multilayer film -- setting -- the sheathing-material obturation section -- an electrode terminal -- letting it pass -- a flow with an electrode and an external terminal -- taking -- hitting -- the obturation section thin in a thick metal wire -- it cannot close -- a thin metal wire -- sufficient conductivity is not securable if independent. Moreover, although the obturation section can be made thin and conductivity can also be secured when a metallic foil is used for an electrode terminal, the adhesion of a thermal melting arrival nature macromolecule membrane layer and a metallic foil (electrode terminal) is bad. Therefore, there were a lifting and a problem which cannot maintain the airtightness of a cell about exfoliation only by slight stress being applied.

[0006] Thus, the airtightness and mechanical strength can be satisfied with the electrode terminal by the metal wire or the metallic foil of a mechanical strength were not able to be obtained. High airtightness is demanded in order that especially a lithium cell may dislike mixing of moisture, although development research is briskly performed from the point that energy density and power density are large.

[0007] This invention is proposed in order to solve the above troubles, and it aims at offering the thin cell which has the outstanding airtightness and a mechanical strength.

[0008]

[Means for Solving the Problem] In order to solve the technical problem which this invention persons mentioned above, as a result of repeating examination wholeheartedly, it found out that the adhesion of a dampproof multilayer film and an electrode terminal was improvable by using a reticulated or porous conductor for an electrode terminal.

[0009] That is, the thin cell concerning this invention is characterized by the electrode terminal to which the dampproof multilayer film which consists of a macromolecule membrane layer and a metallic foil layer comes to contain a positive electrode, a negative electrode, and an electrolyte, and they connect an electrode and an external terminal consisting of a reticulated or porous conductor.

[0010] the above -- as for a reticulated or porous conductor, it is desirable that it is [ of the aggregate of a metal network, an expanded metal, a punching metal, and a carbon fiber ] either at least.

[0011] moreover, the above -- as for a reticulated or porous conductor, it is desirable that it is [ of carbon nickel, aluminum, copper, a tungsten, stainless steel, iron, silver, gold, the alloy containing these, or the metal that plated these ] either at least.

[0012] In the thin cell concerning this invention, since an electrode terminal consists of a reticulated or porous conductor, the poly membrane, for example, the thermal melting arrival nature poly membrane, and the adhesive resin of the obturation section enter and penetrate into the clearance part of an electrode terminal. For this reason, this thin cell can obtain the airtightness which the electrode terminal and the poly membrane stopped being able to exfoliate easily, and was excellent, and a strong mechanical strength.

[0013] Furthermore, as for the thin cell concerning this invention, it is desirable that the thickness of the poly membrane of the obturation section which the poly membrane came to obturate opening of a dampproof multilayer film, and the electrode terminal has penetrated is thicker than other obturation parts. For example, it is good to assign the piece of resin to the field which is equivalent to the obturation section of an electrode terminal, or to cover with resin the field which is equivalent to the obturation section of an electrode terminal.

[0014] It can prevent that an electrode terminal (a positive-electrode terminal and negative-electrode terminal) contacts and connects with a metallic foil layer too hastily the thickness of the poly membrane of the obturation section which the electrode terminal has penetrated by making it thicker than other obturation parts.

[0015]

[Embodiment of the Invention] Hereafter, the gestalt of operation of the thin cell concerning this invention is explained to a detail, referring to a drawing.

[0016] The thin cell which applied this invention is a cell which the sheathing material which consists of a dampproof multilayer film 4 comes to seal where the laminating of a positive electrode 1 and the negative electrode 2 is carried out through a separator 3 and/or a solid electrolyte, or a gel electrolyte, as shown in drawing 1 - drawing 4 . When not using a solid electrolyte, the inside of a cell is filled by nonaqueous electrolyte.

[0017] As shown in drawing 5 , the laminating was carried out to the order of thermal melting arrival nature macromolecule membrane layer 4a, metallic foil layer 4b, and macromolecule membrane layer 4c, and the dampproof multilayer film 4 became, and has turned the thermal melting arrival nature macromolecule membrane layer 4a side to

the interior of a cell.

[0018] And the end of the positive-electrode terminal 5 penetrates thermal melting arrival nature macromolecule membrane layer 4a, and is exposed to the method of outside, and the other end is electrically connected to the positive electrode 1. Similarly, the end of the negative-electrode terminal 6 penetrates thermal melting arrival nature macromolecule membrane layer 4a, and is exposed to the method of outside, and the other end is electrically connected to the negative electrode 2. It may connect with an electrode material or the positive-electrode terminal 5 and the negative-electrode terminal 6 may be connected to a charge collector. Adhesion according [ the approach of connection ] to sticking by pressure, welding, and a conductive ingredient etc. is mentioned. Moreover, as shown in drawing 2 , the positive-electrode terminal 5 and the negative-electrode terminal 6 are pulled out from the opposite side here, but any arrangement is possible, unless both contact and the short circuit of a cell is caused.

[0019] The thin cell which applied this invention is characterized by using a reticulated or porous conductor as the above-mentioned positive-electrode terminal 5 and a negative-electrode terminal 6 (these being hereafter called an electrode terminal collectively.).

[0020] This electrode terminal can take concretely the structure of the shape of a mesh which knit the thin line, the configuration where the thin line was put in order in parallel thinly, and the shape of a mesh which joined the thin line arranged irregularly. Spacing of a thin line has 0.5 times to about 2 desirable times of the diameter of a thin line, or a major axis. Furthermore, this electrode terminal may be the structure with which two or more holes or slitting etc. went into the plate-like conductor.

[0021] As an electrode terminal with such reticulated or porous structure, the aggregate of a metal network, an expanded metal, a punching metal, and a carbon fiber can be used preferably.

[0022] Considering reinforcement and workability, as an ingredient (conductor) of these electrode terminals, carbon, nickel, aluminum, copper, a tungsten, stainless steel, iron, silver, gold, the alloy containing these, or the metal that plated these is effective.

[0023] A different ingredient may be used for an electrode terminal 5, i.e., a positive-electrode terminal, and the negative-electrode terminal 6 even if it uses the respectively same ingredient. From the point of chemical stability, for electrochemical and the positive-electrode terminal 5, aluminum, gold, and carbon are desirable, and copper is desirable for the negative-electrode terminal 6. Especially as a terminal ingredient usable on positive/negative two poles, nickel and stainless steel are desirable.

[0024] By the way, the closure of this cell is carried out by pressing opening (a slash showing among drawing 4 .) which does not lap with the electrode of the dampproof multilayer film 4 which is a sheathing material at an elevated temperature.

[0025] On the occasion of this closure, as shown in drawing 3 and drawing 4 , the electrode terminal mentioned above penetrates thermal melting arrival nature

macromolecule membrane layer 4a, and the closure is carried out to the obturation section X. At this time, that an electrode terminal is reticulated or since it has porosity, thermal melting arrival nature poly membrane 4a enters and penetrates into the clearance part of an electrode terminal, and an electrode terminal and thermal melting arrival nature macromolecule membrane layer 4a on the rear face of front are unified.

[0026] Thus, in the thin cell which applied this invention, since it faces closing and thermal melting arrival nature macromolecule membrane layer 4a enters and penetrates into the clearance part of an electrode terminal, an electrode terminal and thermal melting arrival nature macromolecule membrane layer 4a are joined firmly, it is hard coming to exfoliate, and very good airtightness and mechanical stability can be realized. It is possible for the life of a cell, mothball nature, and mechanical endurance to be improved sharply, and to raise the engine performance of a cell and dependability sharply as the result.

[0027] In addition, it is required that the thickness of this electrode terminal should be thinner than the thickness (sum of the thickness for two front flesh sides) of thermal melting arrival nature macromolecule membrane layer 4a of the obturation section X, an EQC, or it.

[0028] If the thickness of an electrode terminal is too large, when it thermal-melting-arrival-closes, the reticulated fiber of an electrode terminal may break through thermal melting arrival nature macromolecule membrane layer 4a, and internal metallic foil layer 4b may be contacted. A cell will be short-circuited if the electrode terminal of both the positive-electrode terminal 5 and the negative-electrode terminal 6 contacts coincidence at internal metallic foil layer 4b.

[0029] As a means which prevents this short circuit, although thickness of an electrode terminal may be made thinner than the thickness of thermal melting arrival nature macromolecule membrane layer 4a, resin thickness of thermal melting arrival nature macromolecule membrane layer 4a may be thickened conversely. In the closure structure of obturating opening of the dampproof multilayer film 4, it can respond by thickening resin thickness of the resin layer (thermal melting arrival nature macromolecule membrane layer 4a) of the obturation section X which especially the electrode terminal of the dampproof multilayer film 4 penetrates. In this case, it is not necessary to thicken superfluously resin thickness of obturation parts other than the obturation section X.

[0030] It faces closing by the dampproof multilayer film 4, and, as for the resin thickness of this obturation section X, it is desirable to carry out by 2 to 3 times the thickness of an electrode terminal in the condition of having fused, since it must be thicker than an electrode terminal. If this resin thickness is too thick, will allow diffusion invasion of moisture from there and degradation of the cell engine performance will be caused, and also there is a possibility that the configuration of closure structure may become complicated, a wrinkling etc. may arise, and moisture

may invade in a cell from there.

[0031] Although resin thickness of thermal melting arrival nature macromolecule membrane layer 4a of the obturation section X which an electrode terminal penetrates beforehand may be thickened and may be carried out as a concrete means to realize this, the field which is equivalent to the obturation section X of an electrode terminal may be beforehand covered with insulating thermal melting arrival nature resin. Moreover, as shown in [drawing 6](#) - [drawing 9](#) , in case a cell is obturated, the piece 7 of thermal melting arrival nature resin may be assigned and closed to the field which is equivalent to the obturation section X of an electrode terminal.

[0032] In this case, although the polyolefine system resin and polyamide resin same as thermal melting arrival nature resin to be used as thermal melting arrival nature poly membrane layer 4a used inside the dampproof multilayer film 4, vinyl acetate system resin, acrylic resin, an epoxy resin, etc. can be used, it is not limited to these. Moreover, when covering an electrode terminal with insulating resin beforehand, it pastes up good with the layer not only inside thermal melting arrival nature resin but an electrode terminal and the dampproof multilayer film 4 (thermal melting arrival nature macromolecule membrane layer 4a), and any resin can be used if it is chemical stable resin. For example, from the adhesive property and chemical stability, although an epoxy resin is desirable, it is not limited to this.

[0033] Moreover, although doubled with the configuration of a cell about the width of face and the length of an electrode terminal, it is desirable to make it the electrical potential difference produced to the both ends of the electrode terminal at the time of using it as a cell become 1/100 or less [ of the nominal voltage of a cell ].

[0034] On the other hand, the dampproof multilayer film 4 used as a sheathing material consists of thermal melting arrival nature macromolecule membrane layer 4a for pasting up, metallic foil layer 4b for raising airtightness, and macromolecule membrane layer 4c (you may be the poly membrane of thermal melting arrival nature.) for maintaining reinforcement, and the metallic foil layer should just be pinched by the macromolecule membrane layer at worst. Therefore, the laminating of further two or more macromolecule membrane layer metallurgy group foil layers may be carried out.

[0035] Furthermore, as mentioned above, since closing by thermal melting arrival is optimal as for the obturation section X, it is desirable [ the interior side of a cell of the dampproof multilayer film 4 ] that it is thermal melting arrival nature macromolecule membrane layer 4a. However, thermal melting arrival nature macromolecule membrane layer 4a may be transposed to a thermally stable polymer membrane layer, and the obturation section X may be closed not by the thermal melting arrival nature poly membrane but by adhesive resin. When adhesive resin is used, it is also possible to paste up in ordinary temperature.

[0036] Here, the ingredient of the dampproof multilayer film 4 is described.

[0037] As an ingredient of thermal melting arrival nature poly membrane layer 4a for



pasting up, although polyamide resin, such as polyolefin resin, such as polyethylene and polypropylene, and nylon, vinyl acetate system resin, acrylic resin, an epoxy resin, etc. are mentioned, it is not limited especially. Although the adhesive property over a metal or resin and the chemical stability to the electrolytic solution to an epoxy resin is desirable as adhesive resin, it is not limited especially.

[0038] If it is lightweight and flexible and chemically stable as an ingredient of metallic foil layer 4b, it will not be limited especially. Aluminum etc. will be mentioned if it illustrates. Aluminum is advantageous from the field of physical properties and a price.

[0039] As an ingredient of poly membrane layer 4c for maintaining reinforcement, polyolefin resin, such as polyamide resin, such as nylon, polyethylene terephthalate or polyethylene, and polypropylene, is mentioned. Polyethylene terephthalate and Nylon are advantageous from a mechanical strength.

[0040] Moreover, as a dampproof multilayer film 4, well-known general-purpose lamination resin can be used, and it is effective.

[0041] In addition, in the thin cell shown in [drawing 1](#) - [drawing 9](#), although considered as the configuration which closes the periphery section (neighborhood) of the dampproof multilayer film 4, it is not limited to this. From a viewpoint of the production process of a thin cell, as shown in [drawing 10](#) and [drawing 11](#), it faces containing the electrode component 8 by the dampproof multilayer film 4, and three sides of the dampproof multilayer film 4 may be pressed and closed at an elevated temperature (a slash shows among drawing.). Moreover, as shown in [drawing 12](#) and [drawing 13](#), it faces containing the electrode component 8 with the dampproof film 4, and the both ends of the dampproof film 4 may be joined, it may consider as cyclic, and two sides may be pressed and closed at an elevated temperature (a slash shows among drawing.).

[0042] Furthermore, in the thin cell shown in [drawing 1](#) - [drawing 9](#), although it becomes one positive-electrode negative electrode at a time, it is not limited to this structure. For example, it may also be possible to also carry out two or more laminations of the positive-electrode negative electrode and to wind and use, and the number of sheets or area of a positive-electrode negative electrode may not necessarily be the same.

[0043] Moreover, in the thin cell which applied this invention, even if it is a primary-cell specification, it does not matter even if it is a rechargeable battery specification.

[0044] In the case of a primary-cell specification, it is desirable that a negative electrode consists of a metal lithium, a positive electrode consists of an ingredient which can carry out occlusion of the lithium ion, and an electrolyte consists of nonaqueous electrolyte, a solid electrolyte, or a gel electrolyte, and it can use for it what has conventionally well-known all.

[0045] Moreover, in the case of a rechargeable battery specification, it is desirable that a negative electrode consists of either of the ingredients which can carry out the ejection

and insertion of a metal lithium, a lithium alloy, and the lithium irreversibly, a positive electrode consists of an ingredient which can carry out the ejection and insertion of the lithium irreversibly, and an electrolyte consists of nonaqueous electrolyte, a solid electrolyte, or a gel electrolyte, and it can use for it what has conventionally well-known all.

[0046]

[Example] Hereafter, this invention is explained based on a concrete experimental result.

[0047] In <Experiment a> experiment a, the effectiveness of using a reticulated or porous conductor for an electrode terminal was investigated.

[0048] The thin cell shown in one or less example and drawing 3 was produced.

[0049] First, the dampproof multilayer film 4 is the following, and was made and produced. In one side of aluminium foil (metallic foil layer 4b) with a thickness of 7 micrometers, thermal melting arrival of the polypropylene film (thermal melting arrival nature macromolecule membrane layer 4a) with a thickness of 70 micrometers has already been carried out to the polyethylene terephthalate film (macromolecule membrane layer 4c) with a thickness of 12 micrometers at one side, and the dampproof multilayer film 4 with a thickness of 89 micrometers was obtained. This dampproof multilayer film 4 was judged to two sheets and 8cmx10cm, and this was made into the sheathing material.

[0050] Next, a positive electrode 1 is the following, and was made and produced. The dimethyl formamide which is a solvent was made to distribute 90 % of the weight of powder manganese dioxides, 2 % of the weight of powder polyvinylidene fluorides, and 7 % of the weight of powder graphites. And this was applied to the aluminum network of a charge collector, reduced pressure drying was carried out at 100 degrees C for 24 hours, and it pressurized suitably by the roll press further, and compressed to 130 micrometers in thickness. This was started to 4cmx8cm and it considered as the positive electrode 1.

[0051] The negative electrode 2 cut down and produced the lithium metal with a thickness of 300 micrometers to 4cmx8cm.

[0052] The positive-electrode terminal 5 and the negative-electrode terminal 6 cut out and produced the metal network knit so that it might be 75-micrometer spacing and the whole thickness might be set to 110 micrometers in a stainless steel line with a diameter of 50 micrometers to 5mmx3cm. And the positive-electrode terminal 5 was welded to the positive electrode 1, and the negative-electrode terminal 6 was stuck to the negative electrode 2 by pressure.

[0053] An electrolyte is the following, and was made and produced.

[0054] After mixing ethylene carbonate (EC) and propylene carbonate (PC) and making it dissolve, mixed stirring of the polyacrylonitrile (PAN) was carried out, and the viscous solution was adjusted. And the 6 fluoride [ phosphoric acid ] lithium (LiPF<sub>6</sub>) was added in this solution. This obtained the gel electrolyte. In addition, the mol

presentation ratio of the preparation of PAN, EC, PC, and LiPF<sub>6</sub> was taken as PAN:EC:PC:LiPF<sub>6</sub> = 12:53:27:8.

[0055] The nonwoven fabric made from polypropylene PUREN with a thickness of 50 micrometers was used for the separator 3.

[0056] The gel electrolyte stated above was applied to the positive electrode 1 and the negative electrode 2, and the laminating of the dampproof multilayer film 4, a negative electrode 2, a separator 3, a positive electrode 1, and the dampproof multilayer film 4 was carried out to this order. In addition, the thermal melting arrival nature macromolecule membrane layer 4a side was turned to the interior of a cell, and the dampproof multilayer film 4 carried out the laminating.

[0057] And the positive-electrode terminal 5 and the negative-electrode terminal 6 were put between the obturation section X, heating weld of the periphery section which does not lap with the electrode material of the dampproof multilayer film 4 was carried out, the whole was closed, and the lithium primary cell was produced.

[0058] The iron sulfide (FeS<sub>2</sub>) was used for example 2 positive electrode 1, the metal lithium was used for the negative electrode 2, and the lithium primary cell was produced in the same procedure as an example 1.

[0059] The cobalt acid lithium (LiCoO<sub>2</sub>) was used for example 3 positive electrode 1, the metal lithium was used for the negative electrode 2, and the lithium secondary battery was produced in the same procedure as an example 1.

[0060] Concretely, 91 % of the weight (LiCoO<sub>2</sub>) of cobalt acid lithiums, 3 % of the weight of powder polyvinylidene fluorides, and 9 % of the weight of powder graphites were used for the positive electrode 1.

[0061] The cobalt acid lithium (LiCoO<sub>2</sub>) was used for example 4 positive electrode 1, difficulty graphitized carbon was used for the negative electrode 2, and the rechargeable lithium-ion battery was produced in the same procedure as an example 1.

[0062] Concretely, the positive electrode 1 was produced like the example 1 using 91 % of the weight (LiCoO<sub>2</sub>) of cobalt acid lithiums, 3 % of the weight of powder polyvinylidene fluorides, and 9 % of the weight of powder graphites.

[0063] The negative electrode 2 was produced as follows. N methyl pyrrolidone which is a solvent was made to distribute 91 % of the weight of difficulty graphitized carbon, and 9 % of the weight of powder polyvinylidene fluorides, this was applied on copper foil, and reduced pressure drying was carried out at 120 degrees C for 24 hours. And this was further pressurized suitably by the roll press, and it compressed into 200 micrometers in thickness, and considered as the negative electrode 2.

[0064] The cobalt acid lithium (LiCoO<sub>2</sub>) was used for example 5 positive electrode 1, the graphite was used for the negative electrode 2, and the rechargeable lithium-ion battery was produced in the same procedure as an example 1.

[0065] Concretely, the positive electrode 1 was produced like the example 1 using 91 % of the weight (LiCoO<sub>2</sub>) of cobalt acid lithiums, 3 % of the weight of powder

polyvinylidene fluorides, and 9 % of the weight of powder graphites.

[0066] The negative electrode 2 was produced as follows. N methyl pyrrolidone which is a solvent was made to distribute 91 % of the weight of graphites, and 9 % of the weight of powder polyvinylidene fluorides, this was applied on copper foil, and reduced pressure drying was carried out at 120 degrees C for 24 hours. And this was further pressurized suitably by the roll press, and it compressed into 170 micrometers in thickness, and considered as the negative electrode 2.

[0067] As the example of comparison 1 positive-electrode terminal 5, and a negative-electrode terminal 6, the nickel foil with a thickness of 100 micrometers cut to 5mmx3cm was used. Except this, the above-mentioned electrode terminal was connected to the electrode, like the example 1, it closed so that it might put between the obturation section X of the dampproof multilayer film 4, and the lithium primary cell was produced.

[0068] The nickel foil with a thickness of 100 micrometers cut to 5mmx3cm was used as an electrode terminal like the example 1 of example of comparison 2 comparison. Except this, the above-mentioned electrode terminal was connected to the electrode, like the example 3, it closed so that it might put between the obturation section X of the dampproof multilayer film 4, and the lithium secondary battery was produced.

[0069] The nickel foil with a thickness of 100 micrometers cut to 5mmx3cm was used as an electrode terminal like the example 1 of example of comparison 3 comparison. Except this, the above-mentioned electrode terminal was connected to the electrode, like the example 4, it closed so that it might put between the obturation section X of the dampproof multilayer film 4, and the rechargeable lithium-ion battery was produced.

[0070] Evaluation of a characterization example and the example of a comparison performed the retention test, and considered it by measuring the moisture content in a cell.

[0071] That is, it dissolved, after saving the cell of examples 1-5 and the examples 1-3 of a comparison in the atmospheric air of fixed period ordinary temperature normal relative humidity, and the moisture in an electrolyte was measured with the curl Fischer moisture meter. The result is shown in [drawing 14](#).

[0072] Moreover, aging of the open circuit voltage after fixed period preservation to the initial open circuit voltage immediately after production was measured about the cell of examples 1-5 and the examples 1-3 of a comparison. The result is shown in [drawing 15](#).

[0073] Furthermore, the discharge property after ten-week preservation was measured according to discharge current 0.25 mA/cm<sup>2</sup> and discharge conditions with a temperature of 23 degrees C about the lithium secondary battery of an example 3 and the example 2 of a comparison. The result is shown in [drawing 16](#).

[0074] In addition, about the rechargeable battery, the retention test was presented after charge to 80% of the capacity.

[0075] From the result of [drawing 14](#) - [drawing 16](#), the cell of an example 1 - an

example 5 has high airtightness, and shows the high engine performance. On the other hand, thermal melting arrival nature macromolecule membrane layer 4a of the obturation section X and an electrode terminal (nickel foil) exfoliated only by slight stress being applied, moisture mixed, and the cell of the example 1 of a comparison - the example 3 of a comparison has lost the engine performance.

[0076] Moreover, when the negative electrode 2 (metal lithium) was compared in examples 1-3 and the example 1 of a comparison after the trial, in the examples 1-3, the fine particles of off-white which belong to a lithium hydroxide existed so much by the example 1 of a comparison to the lithium having maintained metallic luster.

[0077] By using a metal network for an electrode terminal, the adhesion of an electrode terminal and a thermal melting arrival nature macromolecule membrane layer can be raised, it can prevent that an electrode terminal and a thermal melting arrival nature macromolecule membrane layer exfoliate, and invasion of the moisture which has great effect on the cell engine performance etc. can be prevented so that these results may show. That is, the airtightness of a cell and a mechanical strength can be raised by using a reticulated or porous conductor for an electrode terminal.

[0078] In <Experiment b> experiment b, the effectiveness of thickening the resin layer of the obturation section X was investigated.

[0079] It faced closing example 6 terminal area, and as shown in [drawing 6](#) - [drawing 9](#), after assigning the piece 7 of polyethylene which is the same quality of the material as thermal melting arrival nature poly membrane layer 4a to both-sides both sides which are equivalent to the obturation section X of an electrode terminal, it closed. Thickness of the piece 7 of polyethylene was respectively set to 100 micrometers.

[0080] 1mm of width-of-face + right and left of an electrode terminal, the width of face of the covered polyethylene was doubled and was made into width of face of +2mm of an electrode terminal. 1mm of obturation section X length + both ends, the die length of the covered polyethylene was doubled and was made into +2mm of obturation section X length.

[0081] The lithium primary cell was produced like the example 1 except this.

[0082] Resin thickness which hits the obturation section X of example 7 thermal-melting arrival nature macromolecule membrane layer 4a was beforehand set to 200 micrometers.

[0083] 1mm of width-of-face + right and left of an electrode terminal, width of face was doubled and the part which thickens resin thickness of thermal melting arrival nature macromolecule membrane layer 4a made it width of face of +2mm of an electrode terminal, and 1mm of obturation section X length + both ends, die length was doubled and it made it +2mm of obturation section X length.

[0084] The lithium primary cell was produced like the example 1 except this.

[0085] Both-sides both sides which hit the obturation section X of example 8 electrode terminal were beforehand covered with the polyethylene which is the same quality of

the material as thermal melting arrival nature poly membrane layer 4a. Thickness of polyethylene was made into 100 micrometers of each side.

[0086] 1mm of width-of-face + right and left of an electrode terminal, width of face was doubled and the covering dimension of an electrode terminal made it width of face of +2mm of an electrode terminal, and 1mm of obturation section X length + both ends, die length was doubled and it made it +2mm of obturation section X length.

[0087] The lithium primary cell was produced like the example 1 except this.

[0088] Resin thickness of thermal melting arrival nature macromolecule membrane layer 4a of the example 9 dampproofing multilayer film 4 was set to 200 micrometers.

[0089] The lithium primary cell was produced like the example 1 except this.

[0090] The incidence rate of the defective by the short circuit at the time of assembly completion was investigated to the cell of the characterization example 1 and an example 6 - an example 9. The result is shown in Table 1.

[0091]

[Table 1]

	良品 [個]	短絡による不良品 [個]
実施例 1	3	7
実施例 6	20	0
実施例 7	10	0
実施例 8	10	0
実施例 9	10	0

[0092] The result of Table 1 shows that the defective by the short circuit of a cell is decreasing sharply by the cell of an example 6 - an example 9. On the other hand, by the cell of an example 1, the probability for the positive-electrode terminal 5 and the negative-electrode terminal 6 to break through the obturation section, to contact aluminium foil (metallic foil layer 4b), to cause a short circuit, and to serve as a defective is high.

[0093] By thickening resin thickness of the obturation section which an electrode terminal penetrates, the short circuit of a forward negative electrode can be prevented and the initial failure of a cell can be prevented, such as assigning resin to the obturation  
\*\*\*\* slack side of an electrode terminal, covering, or thickening thickness of the resin which hits the obturation section beforehand, so that these results may show.

[0094]

[Effect of the Invention] According to the thin cell of this invention, since an electrode terminal consists of a reticulated or porous conductor, the adhesion of an electrode terminal and a dampproof multilayer film can be raised, and the outstanding airtightness

and the outstanding mechanical strength can be obtained, so that clearly also from the above explanation. Furthermore, the short circuit of a forward negative electrode can be prevented by thickening resin thickness of the obturation section which an electrode terminal penetrates. Consequently, the life of a cell, mothball nature, and mechanical endurance can be improved sharply, and the engine performance of a cell and dependability can be raised sharply.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is a sectional view in front of the closure of the thin cell which applied this invention.

[Drawing 2] It is a decomposition perspective view in front of the closure of this thin cell.

[Drawing 3] It is a sectional view after the closure of this thin cell.

[Drawing 4] It is the top-face perspective drawing after the closure of this thin cell.

[Drawing 5] It is the sectional view of the dampproof multilayer film of this thin cell.

[Drawing 6] It is a sectional view in front of the closure of the thin cell which assigned the piece of resin to the field which hits the obturation section X of the electrode terminal shown in drawing 1.

[Drawing 7] It is a decomposition perspective view in front of the closure of this thin cell.

[Drawing 8] It is a sectional view after the closure of this thin cell.

[Drawing 9] It is the top-face perspective drawing after the closure of this thin cell.

[Drawing 10] It is a perspective view in front of the closure of another thin cell which applied this invention.

[Drawing 11] It is a perspective view after the closure of this thin cell.

[Drawing 12] It is a perspective view in front of the closure of another thin cell which applied this invention.

[Drawing 13] It is a perspective view after the closure of this thin cell.

[Drawing 14] It is the property Fig. showing the relation between a retention period and the moisture content in an electrolyte.

[Drawing 15] It is the property Fig. showing the relation between a retention period and

the open circuit potential of a cell.

[Drawing 16] It is the property Fig. showing the relation between the discharge capacity of the cell after ten-week preservation, and discharge voltage.

[Description of Notations]

1 Positive Electrode, 2 Negative Electrode, 3 Separator and/or Solid Electrolyte or Gel Electrolyte, 4 Dampproof Multilayer Film, 5 Positive-Electrode Terminal, 6 Negative-Electrode Terminal, 7 Piece of Resin, 8 Electrode Component, X Obturation Section